

Wind power expansion in Brazil: socio-environmental and economic implications

Conference: The coming of age of renewable energy

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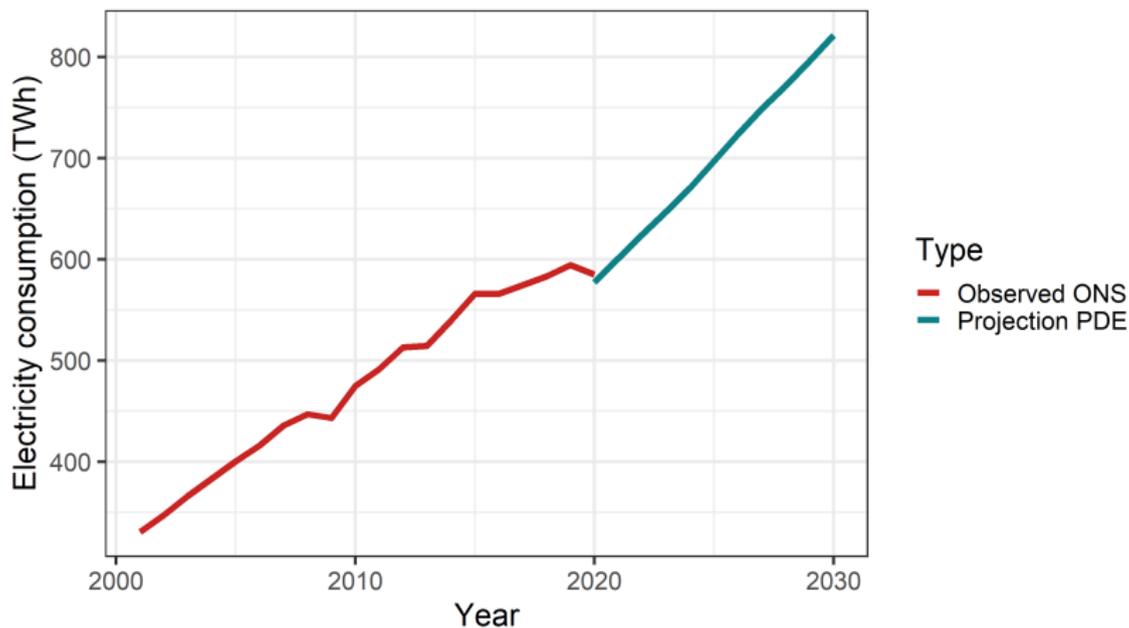
14.4.2021



Content

- ▶ Wind power in the context of the Brazilian electricity system
- ▶ Socio-environmental challenges of wind power
- ▶ A way forward: land-neutrality of renewable energy expansion

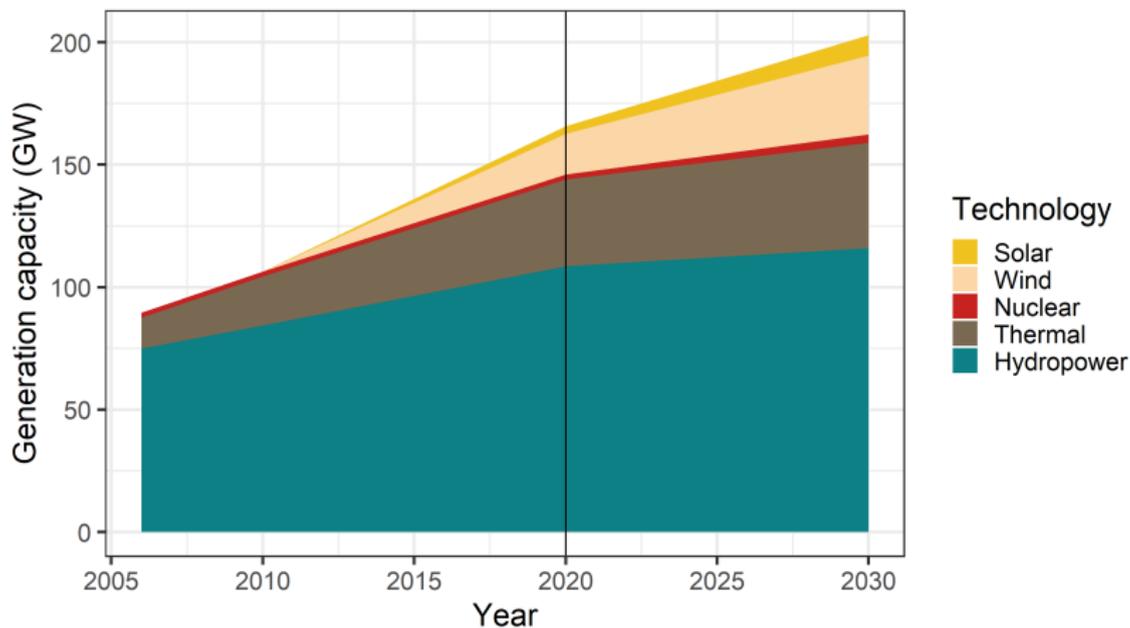
Electricity consumption in Brazil



Source: ONS, EPE



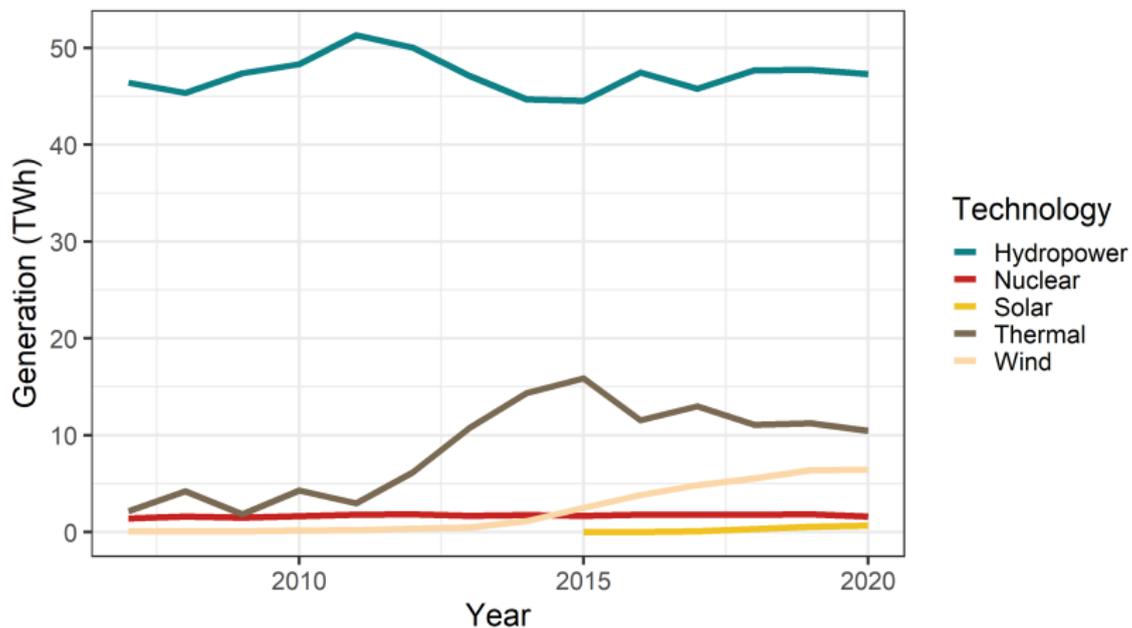
Electricity generation capacity in Brazil



Source: ONS, EPE



Electricity generation in Brazil

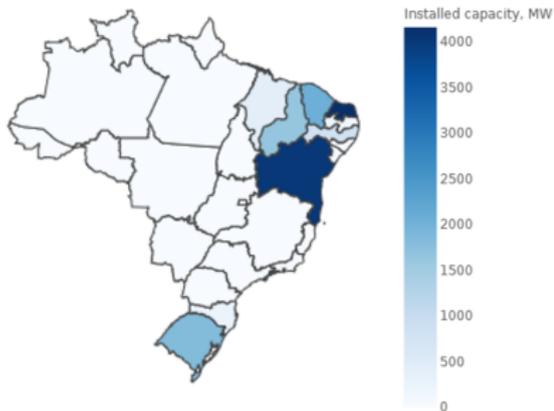


Source: ONS

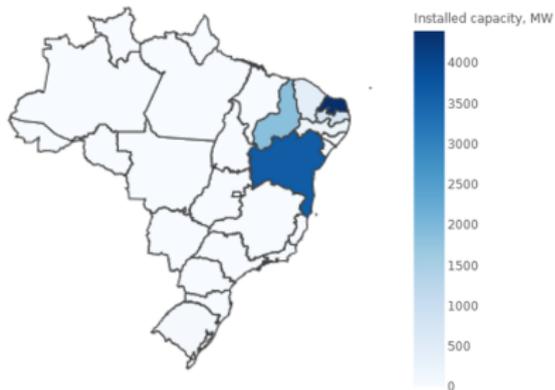


The spatial distribution of wind power generation

Existing capacity

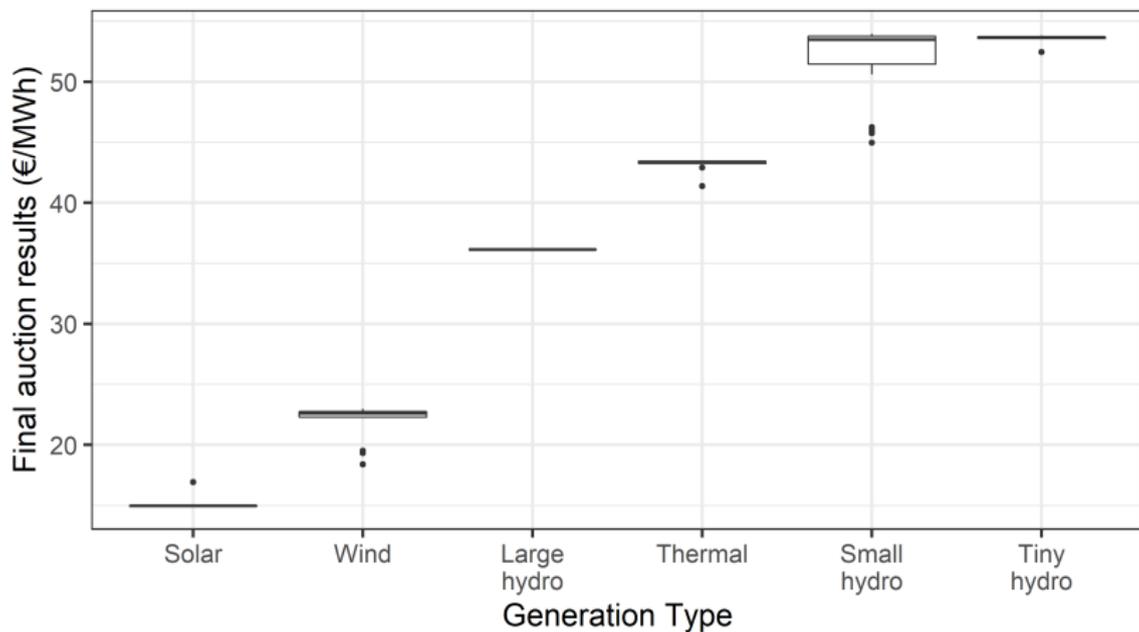


Future capacity (auctioned)



Source: Aneel

Auction results 2019



Source: CCEE



Offshore wind energy development in Brazil

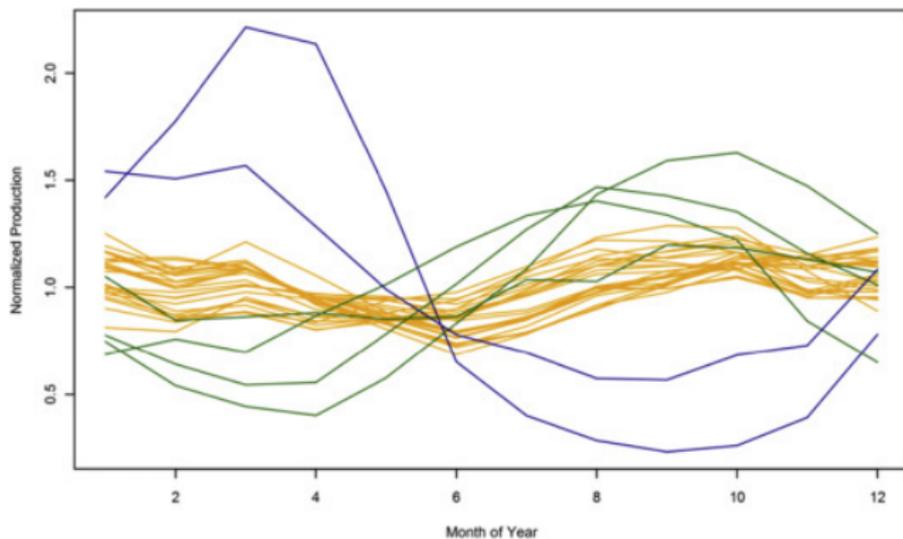
- ▶ Roadmap for offshore wind in Brazil published by EPE.
- ▶ Public energy planning company EPE does not foresee offshore wind until 2027 in Brazil
- ▶ Still, 5 ongoing active development initiatives, in Ceará, Rio de Janeiro, and Rio Grande do Sul (Brazilian, Italian, and Spanish investors).

Source: Xavier et al. (2020).

https://www.researchgate.net/publication/345726759_Energia_eolica_offshore_e_pesca_artesanal_impactos_e_desafios_na



Wind and hydro-power complementarity

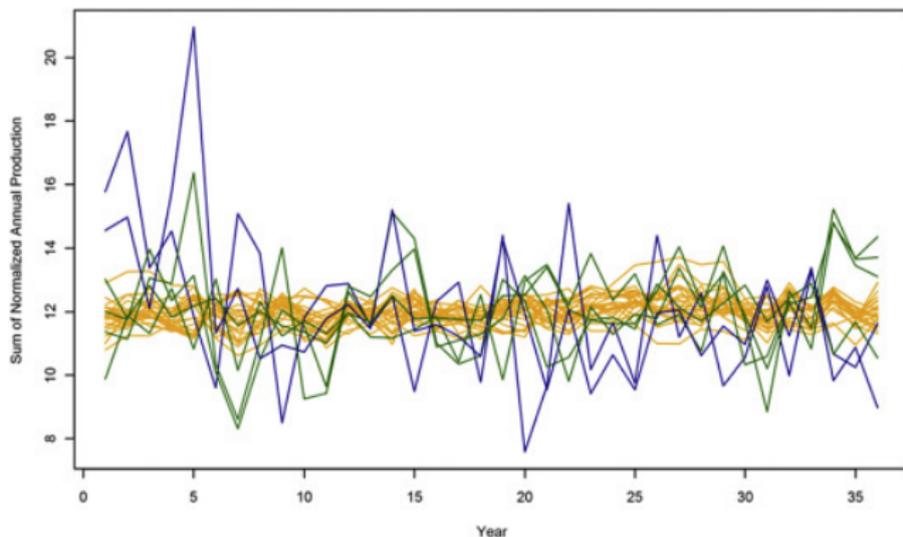


Hydropower, Windpower, Solar

Schmidt et al. (2016). <https://www.sciencedirect.com/science/article/pii/S0360544216303036>



Multi-annual variability of renewables in Brazil

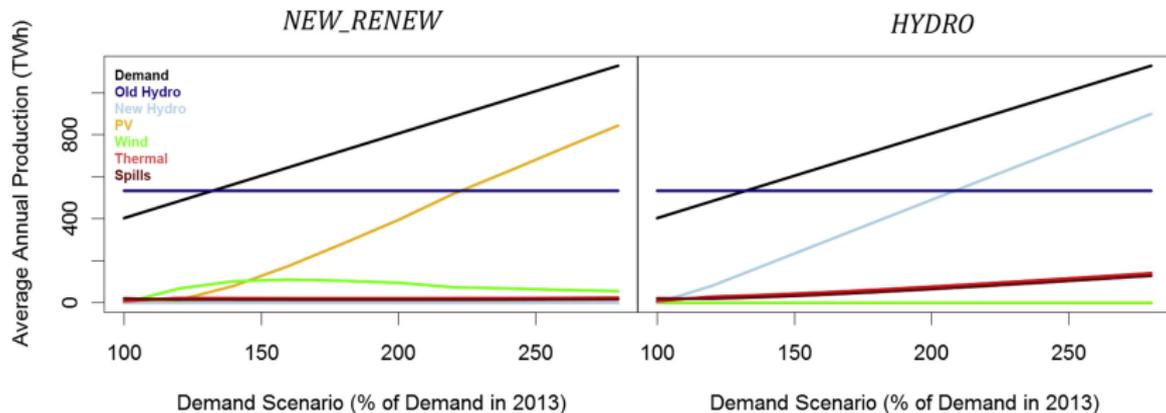


Hydropower, Windpower, Solar

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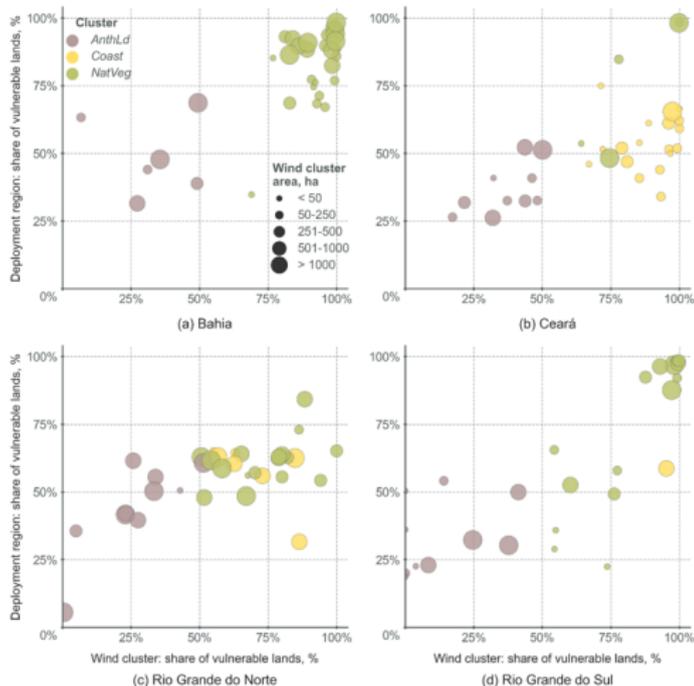
An electricity system with high shares of renewables in Brazil



Schmidt et al. (2016). <https://www.sciencedirect.com/science/article/pii/S0960148115300331>

Environmental challenges

- ▶ Wind turbines in Bahia and Ceará built on native vegetation and sand dunes
- ▶ Highly sensitive ecological areas
- ▶ Observed land-use change in wind park areas low on average, but high variation
- ▶ Will other development follow?



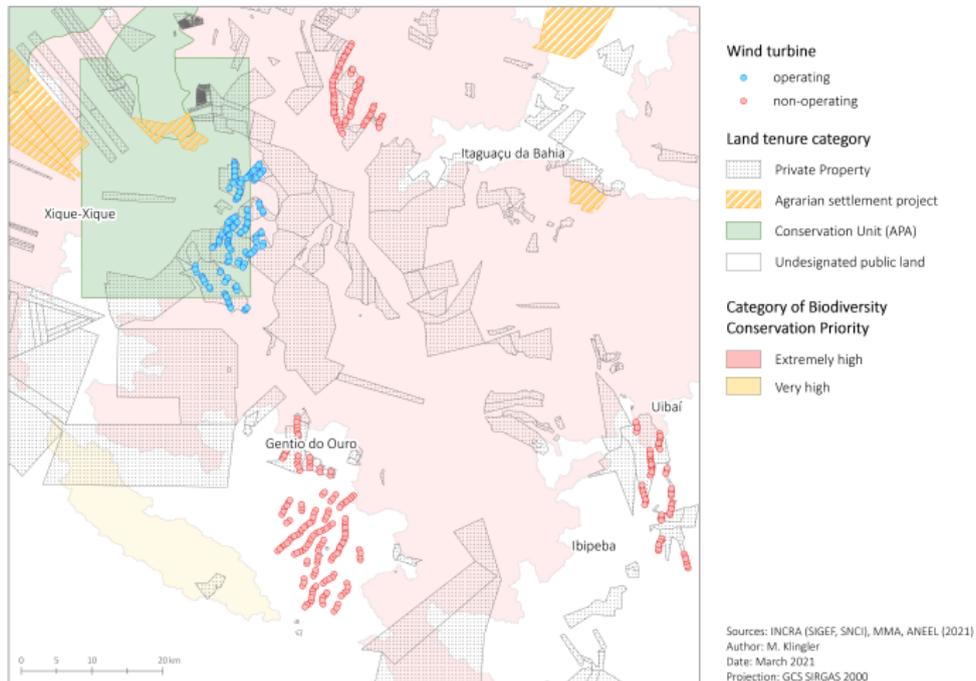
Source: Turkovska et al. (2021).

<https://iopscience.iop.org/article/10.1088/1748-9326/abd12f>



Land tenure challenges

Case study: Gentio de Ouro



Documented conflicts

Case study: Gentio de Ouro

- ▶ Brotas de Macaúbas wind parks (2009): Irregular property boundaries, conflicts with traditional communities
- ▶ Usina Eólica Nova Canarana (29.4MW): contractual problems on land of fundo e fecho de pasto communities (2018)
- ▶ 46 communities close to Xique-Xique threatened by illegal land titles ("grilagem de terra"). Wind power companies, among others, are interested in respective land (2015)
- ▶ Complexo Eólico Capoeiras e Assuruá (implemented in 2016): illegal appropriation of 8,000 hectares of public land.

Sources:

Comissão Pastoral da Terra (2019). *Conflitos no Campo*.

Silva Ribeiro, C., dos Santos Araújo, C., Garcia de Oliveira, G., Inez Germani, G. (2018). Aspectos econômicos e jurídicos que cercam a relação de camponeses com empresas exploradoras de energia eólica no município de Brotas de Macaúbas – Bahia.

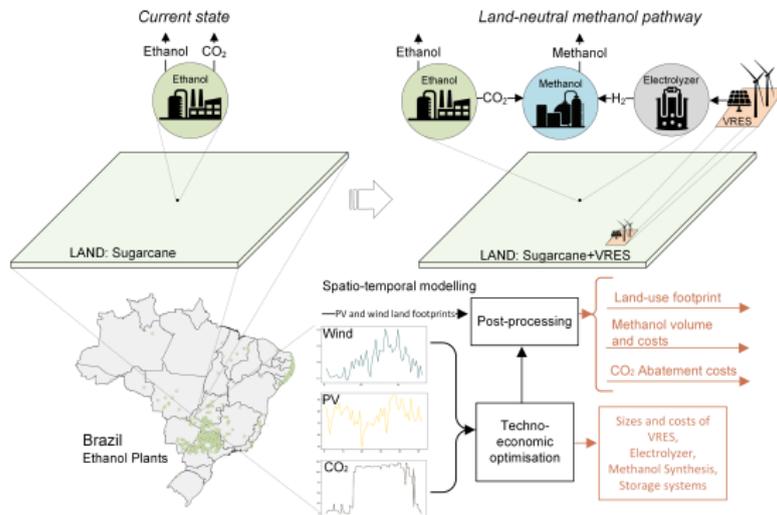
Associação de Advogados de Trabalhadores Rurais no Estado da Bahia (2017). *No Rastro da Grilagem*.



Land neutrality as way forward?

Brazil uses substantial amount of land for biofuel production.

- ▶ In combination with wind/solar PV output increase by 50%.
- ▶ With Direct Air Capture of CO_2 , output increases 10 times
- ▶ Observation: concurrent expansion of biofuels & possibly green ammonia



Some tentative conclusions

- ▶ Brazilian wind power sector growing strongly. Until 2030: projected to double. PV as competitor?
- ▶ Main focus in North-East Brazil, offshore wind power earliest in 2027
- ▶ Wind resources and environmentally and socially sensitive areas overlap
- ▶ Taking socio-environmental criteria in the energy transition seriously
 - ▶ Complexity of existing land tenure situations
 - ▶ Participation, active decision taking, and compensation of hosting communities
 - ▶ Accounting for environmental impacts, in particular on biodiversity
 - ▶ Reducing land use for land-intensive biofuel production to open room for wind power and solar PV